CHAPTER 11. SIGNS, TRAFFIC, AND OBSTRUCTION MARKING

Section 1. SIGNS

11.1.1 GENERAL. The main purpose of signs is to supply information for identification, direction, and safety. Signs also are used for guiding, controlling, expediting, and safeguarding traffic movement of vehicles and equipment as well as pedestrians. Base materials used for signs include posterboard, hardboard, wood, metal, concrete, and masonry. The choice of substrate for portable or removable signs depends on the environment and service life required. Exterior signs must be more durable than interior signs and should be painted in the same manner as other exterior surfaces, especially since legibility is of utmost importance. Material selection is usually governed by durability, appearance, and initial cost. Low initial cost may result in poor economy. On the other hand, high initial cost is not justified when damage or vandalism may necessitate frequent replacement of signs. See section 3 of this chapter for references and standards.

11.1.2 METHODS OF SIGN PREPARATION. Signs are prepared by four general methods listed below and further described in the paragraphs indicated:

(1)	Freehand painting	paragraph 11.1.4
(2)	Stenciling	paragraph 11.1.5
(3)	Screen processing	paragraph 11.1.6
(4)	Pressure sensitive overlays	paragraphs 11.1.7 and 11.1.8

Freehand painting shall be done by qualified personnel and only if the sign is not to be duplicated several times or is too large for preparation by other methods. Use stenciling methods if several copies are required or if qualified personnel are not available to produce the sign by freehand painting. Use screen processing when many copies are required. Pressure sensitive overlays are easiest to use since the lettering and common symbols are already prepared. Also, light reflecting materials can be used in the background, or in the lettering, or in both as further described in paragraph 11.1.8. See Figure 11-1 for letter sizes.

11.1.3 BACKGROUND SURFACE. Surface preparation depends on the substrate, its condition, the background color desired, the environment in which the sign will be placed, and its expected service life. Posterboard signs for temporary use indoors need no surface preparation provided that the background color is satisfactory. Posterboard can be obtained in a variety of colors, ready for immediate sign preparation. If the sign is required for long periods, e.g., a few years, or is to be exposed outdoors, a more durable substrate must be used to insure a long service life. Paint all exposed surfaces with a coating system specified for the substrate and the environment as outlined in Chapters 7 and 8. Select a background paint which is suitable for the substrate and environment and which is available in the desired color. The paint must level well and dry fairly hard to avoid damage during sign preparation. Leveling is best accomplished by spray application. A fairly low gloss is desired to obtain optimum sharpness of lettering. Typical examples of background paints are as follows:

Interior Use. TT-E-529 (Semigloss--choice of colors) or TT-E-543 (Undercoat--white and tints) may be used on all surfaces. Concrete and plaster should be primed before use. (See Appendix D-4, Tables 9 through 12.)

Exterior Use. TT-E-489 (Gloss--choice of colors) may be used on metal; TT-P-37 (Gloss-colors) or TT-P-52 (Semigloss--white and colors) may be used on wood; TT-P-19 (Flat--white and colors) or TT-P-1181 (Flat--tints and colors) may be used on concrete and masonry. (See Appendix D-4, Tables 13 through 15.)

Allow background paint to dry thoroughly before lettering the sign.*

Letter sizes will necessarily depend upon the amount of wording and the amount of space available for the sign message. The following table shows the distances at which well proportioned letters of different heights can be read by persons of normal vision, under good lighting conditions:

Height of letters (in)	Distance visible* (ft)
3 1/2	170
3	140
2 1/2	110
2	95
1 3/4	80
1 1/2	70
1 1/4	60
1	50
7/8	40
3/4	30
5/8	20
1/2	20
3/8	15
1/4	12

*Distances specified do not include any allowance for various color combinations. Sizing shall be appropriate for the message involved and attention desired.

FIGURE 11-1
Sign Lettering

11.1.4 FREEHAND SIGN PAINTING. Hand letter the sign using artists lettering brushes (Federal Specification H-B-118). Use paints that are either bulletin colors or TT-P-381, Tinting Colors, thinned to a semipaste consistency, using a mixture of equal parts of TT-L-190, Boiled Linseed Oil, and either turpentine or mineral spirits. Allow the lettering to dry completely before placing sign in service.

*Note.-Be especially careful in the preparation of metal signs made of aluminum or galvanized steel. Flaking may remove parts of the lettering and make the sign useless. (See Appendix D-4, Table 16.)

11.1.5 STENCILING. Stenciling is a rapid means of preparing signs by the use of thin, nonporous material in which the lettering or design is cut, leaving openings through which the stencil paint can be transferred directly onto the surface of the sign.

11.1.5.1 Stenciling Materials. The stencil is made of treated paper such as parchment or oak tag, thin plywood, or metal. Lettering is also available in various sizes already stamped into adjustable metal stencils. Use either bulletin colors or TT-P-381, Tinting Colors, thinned to a semipaste consistency with a mixture of equal parts of TT-L-190, Boiled Linseed Oil, and either turpentine or mineral spirits. MIL-P-15149, Stencil Paint, may be used if signs are used indoors or for temporary use outdoors, e.g., no more than a few months. Stenciling may be done by brush, roller, spray. For brushing use an artist's stencil brush (Federal Specification H-B-621, Type L). For roller application use a special roller, 2 inches wide and 1 1/2 inches in diameter with a renewable short napped cover. The spray gun is of a small size, either an artist's air brush or touch-up spray gun.

11.1.5.2 Preparing the Stencil. The stencil may be cut by hand or machine. Machine cutting is much faster provided that letters of one size are satisfactory. Hand cutting is required for mixed sizes and for special lettering and designs. The stencil is first outlined, preferably from a master alphabet with letters of the desired size, and is then cut with a sharp knife (see Figure 11-2). It is good practice to make a duplicate stencil which should be filed to save time if the original is lost or damaged. Since the stencils are difficult to file and are easily torn if not separated, separate them with uncut stencil board or waxpaper.

11.1.5.3 Using the Stencil. Place the stencil on the prepared substrate, hold firmly, and apply the stencil paint across the cut-out areas so that it goes through to the sign (See Figure 11-3.)

a. Brush Application: Spread the stencil paint in a thin film on a glass or metal sheet by means of a stencil brush or rubber roller. Dip the end of the stencil brush in the thin coating and then transfer the paint to the cut-out areas by tapping the brush tips against the surface. Avoid brushing across the stencil or overloading the brush with paint since this will force the paint under the stencil causing a smear.

b. Roller Application: Spread the stencil paint on the plate as described above. Pass the roller across the thin film until it is uniformly covered with paint. Immediately roll it across the cut-out areas of the stencil.*

c. Spray Application: Using an airbrush, spray the paint quickly, covering just the cut-out areas of the stencil. Use just enough paint to cover the area, and avoid going over the area again unless absolutely necessary. Stencils for spraying should be considerably larger than the cut area. If not, they should be masked.

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*Note.-The roller should never be wider than the stencil.

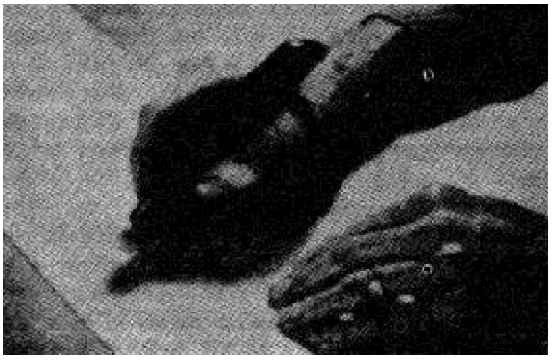


FIGURE 11-2
Cutting Stencil

FIGURE 11-3
Stenciling

When the stencil paint has been applied, carefully remove the stencil directly away from the work, without sliding or moving it sideways, to avoid smearing the wet paint. Immediately fill in all the "tie" areas (uncut strips connecting parts of letters, such as "A", "0", "Q" etc.). Do this with a small flat brush before the paint sets up.

11.1.6 SCREEN PROCESSING. Screen processing is a fast and economical method of making many copies in one or more colors. It should be done only by trained operators. Prints can be made on all surfaces which can be handled in the shop; namely, paper, wood, metal, hardboard, glass, plastic, and fabric. Also, various types of paint can be used such as oil colors, lacquers, and enamels which are specifically formulated to have the characteristics required for screen printing.

11.1.6.1 Screen Processing Materials. The following equipment and supplies are used in screen preparation of signs. (See Figure 11-4.)

a. Printing Frame: This is a rectangular frame, generally made of wood, to which is attached a thin open weave screen, usually made of silk, and on which the lettering is prepared in a manner similar to that used in cutting a stencil. The frame is hinged to a baseboard so that it can be raised to allow the sign to be placed underneath during the printing process.

b. Baseboard: The sign to be painted is supported on a flat, horizontal baseboard. This can be a table top or a large drawing board. It must be absolutely flat and smooth.

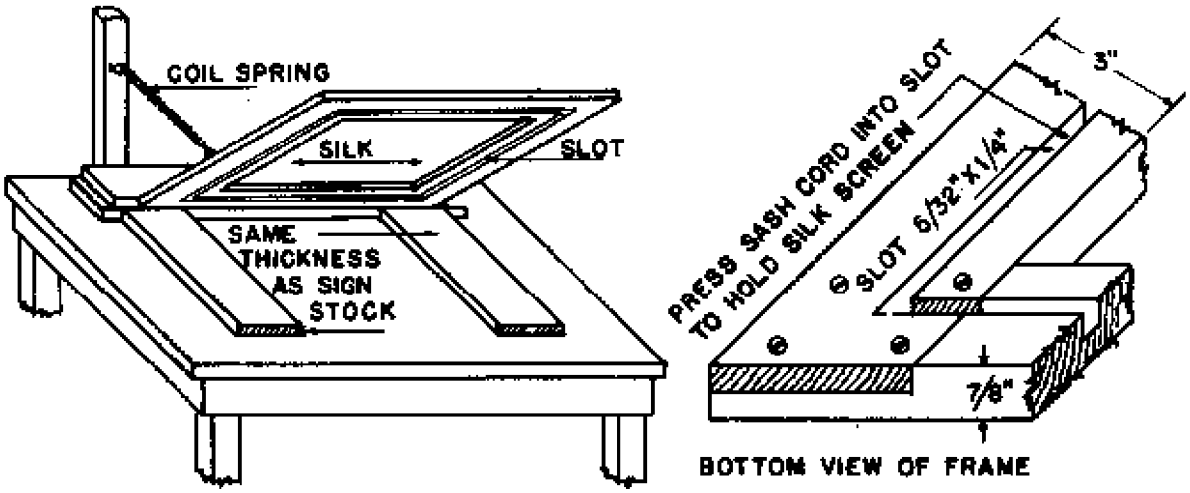


FIGURE 11-4
Screen Printing Setup

c.. Stencil Film: The material used for cutting the stencil is a thin transparent lacquer-like film attached to a thin, translucent waxpaper or plastic backing which is removed after the stencil is adhered to the silk screen.

d. Squeegee: The squeegee is made of a stiff strip of rubber mounted within a wooden handle. It is used to spread the paint across the screen so that paint is forced through the cut-out stencil openings onto the sign.

e. Drying Rack: This is used to support and separate the printed signs as they dry after printing.

11.1.6.2 Preparing the Screen. The screen is made by stretching the silk taut and fastening it to the rectangular frame. The stencil is prepared by cutting the lacquer film in the same manner as a paper stencil, except that the cut is made only through the film and not through the backing paper. The stencil is then adhered to the silk and the backing removed to expose the cut-out areas. (See Figure 11-5.)

11.1.6.3 Screen Printing. Place the sign to be printed in the proper position on the baseboard and underneath the printing frame. Drop the frame gently onto the sign, making sure that contact with the screen and its adherent stencil is complete. Place a small amount of paint on the screen above the stencil and spread it evenly across the printing frame using the squeegee. Lift the frame, remove the printed sign and place it into the rack to dry. If more than one color is to be printed, use a different screen for each color and be sure that each color has dried thoroughly before applying the next color. (See Figure 11-5.)

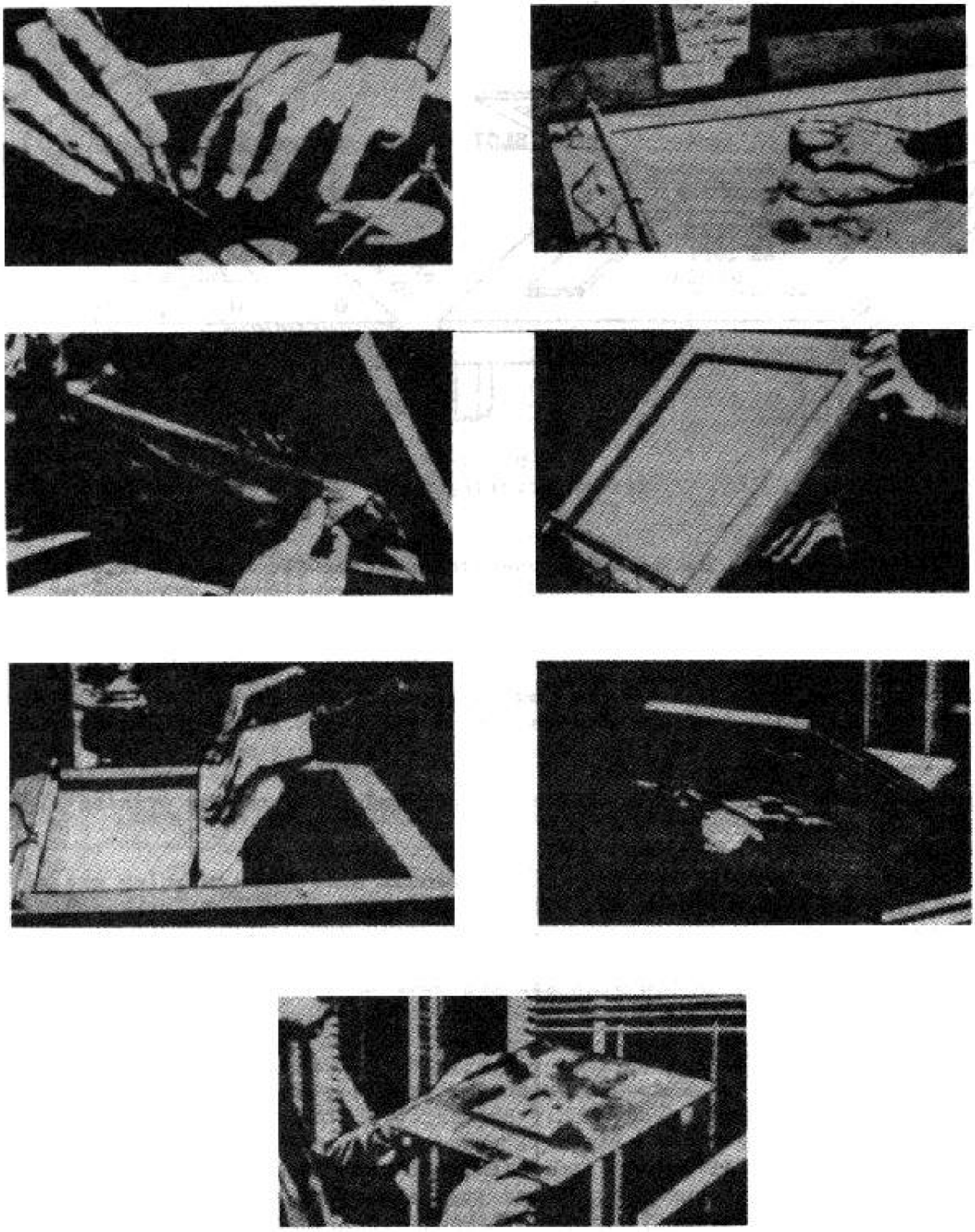


FIGURE 11-5
Screen Printing

11.1.7 PRESSURE SENSITIVE OVERLAYS. These are factory prepared letters, decals, emblems, numbers, symbols or standard signs with an adhesive backing. They are furnished in various sizes and colors. Overlays are applied to the sign or background surface by removing the backing and pressing the figures or entire sign into place.

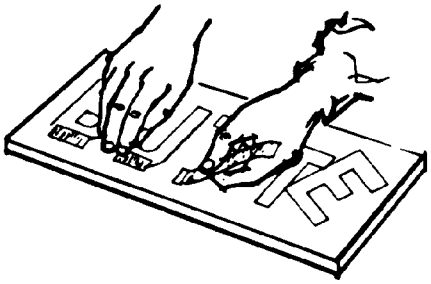
11.1.7.1 Materials for Overlays. The materials required for application of pressure sensitive overlays are the figures, a rubber roller, tweezers, and a decorator's tape. Smaller figures are attached to a sheet of specially-treated paper from which they can be removed readily. Large figures are supplied separately with the backing paper attached to each figure.

11.1.7.2 Application of Overlays. To align the figures in the sign's lay-out, draw light horizontal lines. To help in the proper spacing of smaller figures, draw light vertical lines. Small figures are handled with tweezers. Remove each one from the backing paper individually and carefully place in position before applying finger pressure. Large figures are laid out on the horizontal lines and adjusted for proper spacing. Proper alignment and spac-ing of letters can be achieved by the use of a special device available for the purpose. Attach a small piece of tape to the bottom of each letter to keep it in place. Swing letters back, remove backing paper, then carefully fold back and press into place. Finally, roll all figures smooth using firm pressure to ensure complete contact. (See Figure 11-6.)

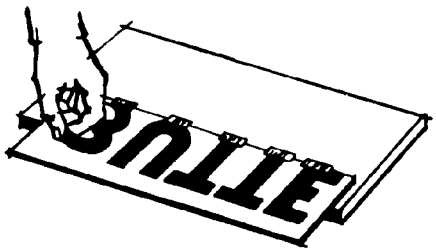
11.1.8 REFLECTORIZED SIGNS. Reflectorized signs provide the greatest degree of safety for both motorist and pedestrian during non-daylight hours; instal-lations are encouraged to utilize reflectorized signs to the greatest extent practicable. In addition, with the emphasis on energy consumption and reduc-tion of lighting intensities along with the increased cost in present methods used in the maintenance of signs, greater use of reflectorized signs with a greater life expectancy should be considered. Therefore, review of present methods to effect economies along with maximizing upgrading of traffic warning and guidance signs for the safety of personnel is recommended and encouraged.

11.1.8.1 Material. All reflectorized signs shall conform to the require-ments of Federal Specification FP-79 published by the Federal Highway Admin-istration. FP-79 provides requirements for reflective traffic sign materials (Section 633 and 718) in the order of their reflective performance and dura-bility. Recommended material and use are as follows:

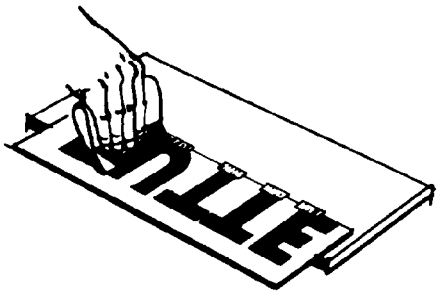
a. Table V, III A (Encapsulated Lens). This material should be used for all critical regulatory, warning, street name signs, street names, directional signs and building numbers. This material provides the greatest amount of high intensity reflectivity and greater safety than other types. The Type III sheeting material is more expensive by approximately 40 percent, but its life expectancy is considerably longer. Recent documents published by the Federal Highway Administration indicated the average life of Type III sheeting is about 14 years. When considering the time and costs involved in assembly, installations, and replacement, the use of Type III sheeting results in annual signing costs which are equal to or lower than the costs for signs utilizing Type II sheeting.



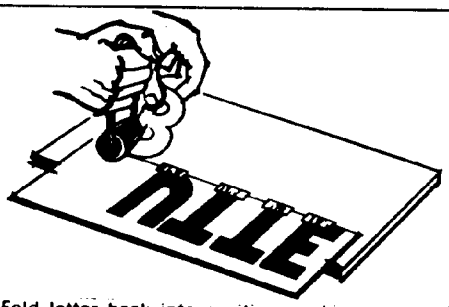
1. Place letters in layout position, adhesive side down, on sign surface. Fasten one edge of each letter with a small piece of masking tape.



2. Swing letters back onto a piece of cardboard or absorbent paper, using the tape as a hinge, and remove the paper liner.



3. Wet felt squeegee with A-2 Activator. Blot excess liquid on a clean rag. Draw squeegee *evenly* across the adhesive.



4. Fold letter back into position, making sure to hold one edge away from sign surface while rolling or while pressing to the surface with a plastic scraper.

5. Re-roll all the letters.

a. Individual Letters

b. Entire Sign Face

FIGURE 11-6
Application of Overlays

b. Table IV, Type II, (Engineer Grade). This material may be used for less critical signs, such as parking signs, organizational signs, construction zone signs and signs intended for interior and/or exterior pedestrian usage. The life expectancy of this material is approximately seven (7) years.

c. Table III, Type I, (Commercial Grade). This material may be used for interior signs or signs that are continuously changing. The life expectancy of this material is approximately four (4) years.

11.1.8.2 Application/Preparation. Older reflectorized signs prepared on a special substrate containing glass spheres which reflect light and thus increase night visibility considerably may still be used; however, pressure-sensitive, reflectorized, adhesive lettering is recommended. For temporary signs the reflective backing may be paperboard (MIL-P-13818). Pressure-sensitive adhesive sheeting material described above may be attached to any solid substrate. Aluminum may be used if decreased and etched. When applying overlay to in-place signs, surfaces shall be thoroughly cleaned with paint thinner or mineral spirits before installing overlay.

11.1.9 APPLICABLE SPECIFICATIONS. The products which are specified for use in signing are listed in Appendix D-l, Table 7. When Federal Standards have been established, sign colors shall be designated according to approved standards.

Section 2. TRAFFIC OBSTRUCTION

11.2.1 GENERAL. Traffic paints are applied on traffic-bearing surfaces of airfield pavements, streets, highways, tunnels, bridges, and parking areas to direct and control traffic. Traffic paint markings help to control movement of pedestrians, as well as operations such as warehousing. These paints are also used to promote safety by marking safety zones, walkways, obstructions and other traffic and pedestrian control devices, and for the preparation of signs directly on pavements. (See section 1 of this Chapter for the materials used and methods of preparation of road and safety signs.) Traffic paints are applied on a variety of substrates such as concrete, bituminous (asphaltic), brick, and stone substrates outdoors, and wood and concrete substrates indoors. See section 3 of this Chapter for references and standards.

11.2.2 TYPES OF PRODUCTS AVAILABLE. Traffic paints are available as reflectorized and nonreflectorized coatings. Reflectorized paint is preferred where improved night visibility is desired.

11.2.2.1 Reflectorized Traffic Paints. Reflectorized paint consists of two components, a pigmented binder and either of two types of reflective media: reflectorized granules or glass spheres. The reflective particles are dropped on to the surface of the applied paint while it is still wet.

11.2.2.2 Pigmented Binders. Both reflectorized and nonreflectorized traffic paints are available in the following coating vehicles:

Alkyd: relatively slow dry, nonbleeding
Alkyd-chlorinated rubber: fast dry, tends to bleed on asphalt
Vinyl toluene-butadiene: fast dry, nonbleeding

Nonreflectorized traffic paints are also available in a moisture-cure, oil-free urethane vehicle for use on indoor floors such as in warehouses and gymnasiums.

11.2.2.3 Colors. Both reflectorized and nonreflectorized traffic paints are available in white and yellow. Nonreflectorized paints are available also in black, grey, red, and green.

ll.2.2.3a Colors for Obstructions to Flying. Obstructions to flying shall be painted in the pattern prescribed by FAA publication, Obstruction Marking and Lighting. International orange enamel and white enamel shall conform to TT-E-489. Where vinyl or vinyl alkyd paints are specified, these paints shall comply with the specifications indicated here.

11.2.3 APPLICABLE SPECIFICATIONS. Products which are specified for use as traffic marking paints are listed in Appendix D-1, Table 8.

11.2.4 SURFACE PREPARATION. To obtain full service potential, marking paints must be firmly anchored to a thoroughly cured and clean substrate. Flexible pavements should be allowed to cure as long as practicable before

marking paints are applied; this will prevent bleeding or undue softening of the asphalt by the paint. Careful attention must be given to cleaning and preparation of the surface. Before marking concrete pavements that have been cured with a membrane-type curing compound, remove the curing compound from the area to be painted by high pressure water blast cleaning. Make sure that the surfaces on which traffic paints are to be applied are dry and free of fuel, oil, grease, dirt, and loose or flaking paint. Follow applicable procedures listed in previous chapters depending on the substrate and environmental conditions.

11.2.5 SELECTION OF COATINGS. Use only those traffic marking paints specified in Appendix D-1, Table 8. TT-P-115 is for general use. Use Type I where relatively slow drying can be tolerated and bleeding is a problem, e.g., on bituminous pavements; Type II for fast drying where bleeding is a problem and Type III for fast drying where bleeding is no problem. TT-P-110 is used where black marking is desired as on light pavements or for signs. It also can be used to obliterate white and yellow traffic markings when they are no longer desired. TT-P-85 and TT-P-1952 are used as reflectorized and nonreflectorized paints for airfield pavement marking. These products are also suitable for roadway marking with or without reflective media. TT-C-542 is a heavy duty, highly abrasion resistant coating which can be used for marking interior floors such as in warehouses and gymnasiums.

11.2.6 PREPARATION OF COATING FOR USE. Be sure that paints and pigmented binders are well mixed and uniform before they are applied. Review Chapter 4, section 3 for procedures. If a line striping machine is to be used, test the paint in the machine. Add a small amount of appropriate solvent only if necessary to adjust viscosity for proper application.

11.2.7 APPLICATION OF COATINGS. Take extreme care to apply the correct amount of traffic paint, as specified, to assure that the proper film thickness is obtained. Traffic marking paints are applied at thicknesses above that of other paints in order to increase their life as the surface is abraded under traffic. The usual range of wet film thickness is 14 to 16 mils which is equivalent to a spreading rate of 100 to 150 square feet per gallon. Traffic paints may be applied by brush, roller, or spray, but are usually applied by mechanical traffic line striping equipment. Mechanical equipment is mandatory for airfield marking. This equipment is available in various sizes depending on the area to be covered. The three most common sizes are a small hand propelled model (Figure 11-7), a self-propelled model (Figure 11-8) and a large truck model (Figure 11-9) to cover large areas, such as airfield pavements. Reflectorized paint is supplied in two parts in separate containers. One contains the pigmented binder (paint) and the other a measured amount of reflective media. Apply the pigmented binder at the specified film thickness as described on page 11-9. Then before the paint sets up, drop the reflective media on the surface of the wet paint so that they are embedded in the film. Be sure to apply the media uniformly and at the prescribed rate. The reflective media can also be applied by means of line striping equipment provided with a dispenser which accurately deposits the correct amount of reflective media as the stripe is made.

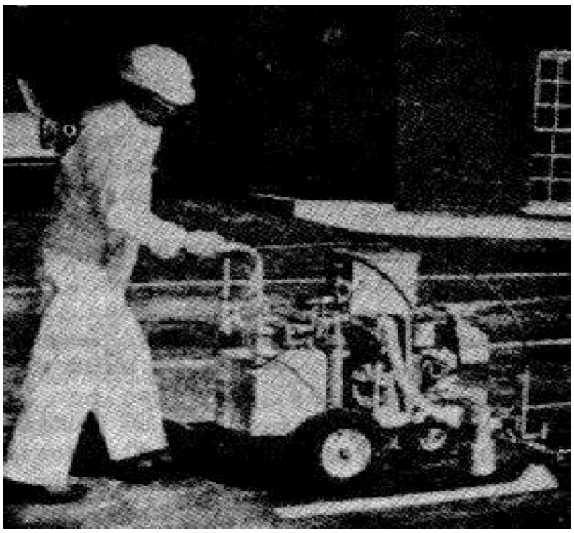


FIGURE 11-7
Hand Propelled Traffic Marker

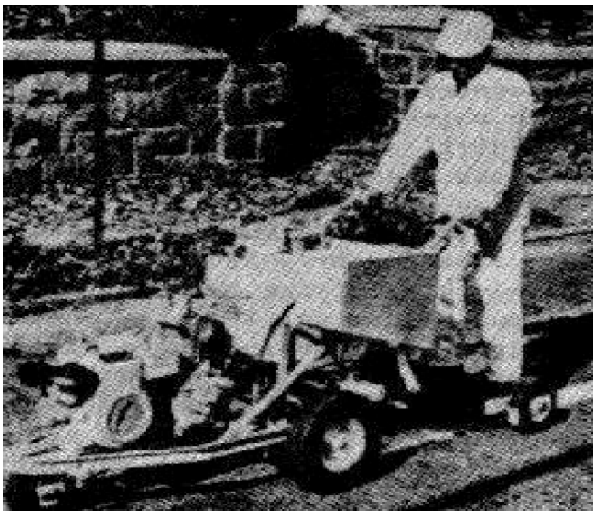


FIGURE 11-8
Self-Propelled Traffic Marker

FIGURE 11-9
Traffic Marker--Truck Model

Section 3. REFERENCES AND STANDARDS

11.3.1 REFERENCES, STANDARDS, MANUALS AND REGULATIONS. Consult the following publications for requirements for signs and for traffic and other special markings:

ANSI Standards, American National Standards Institute, New York, N.Y. 10018:

A10.8	(February 1974)
A14.3	Safety Code for Fixed Ladders
Z35.1	Industrial Accident Prevention Signs

AWWA Publications and Standards, American Water Works Association, New York, N.Y. 10016:

D102	Painting and Repainting Steel Tanks, Standpipes, Reservoirs, and Elevated Tanks for Water Storage

Department of Defense, The Pentagon, Washington, D.C. 20301:

MIL-STD-101	Color Code for Pipelines and for Compressed-gas Cylinders
MIL-STD-161	Identification Methods for Bulk Petroleum Products Systems Including Hydrocarbon Missile Fuels
MIL-STD-457	Frequency for Inspection and Cleaning of Petroleum Fuel Operating and Storage Tanks

Department of the Army, Corps of Engineers, Washington, D.C. 20315:

TM 5-624	Roads, Runways and Miscellaneous Pavements
TM 5-807-7	Color for Buildings
TM 5-823-4	Army Airfield-Heliport Operational and Maintenance Facilities
TM 5-824-4	Airfield Operational and Maintenance Facilities (same as AFM 88-6, Chapter 7)
TM 9-1300-206	Care, Handling, Preservation, and Destruction of Ammunition

Department of the Air Force, Washington, D.C.:

AFM 127-101	Industrial Safety Accident Prevention Handbook
AFR 11-15	Identification of USAF Installations and Buildings
AFR 161-10	Precautionary Measures for Handling Solvents
AFR 161-18	Use of Potentially Toxic and Hazardous Materials
AFM 88-14, Chapter 4	Visual Aid Navigation Facilities
AFP 161-1-1	Respiratory Protective Devices
TO-00-25-232N	High and Low Pressure Terminology
TO-34Y1-1-171	Hydrostatic Testing
AFM 86-8	Airfield Space Criteria
AFM 88-16	Standards for Marking Airfields

Department of the Navy, Washington, D.C.:

NAVMAT Instructions, available at U. S. Naval Publications and Forms Center, Philadelphia, PA 19120. Telephone number: AUTOVON 442-3321; commercial (215) 697-3321.

NAVMAT P-5100	Safety Precautions for Shore Activities

NAVFACENGCOM Design Manuals and P-Publications

Government agencies may obtain Design Manuals and P-Publications from the U.S. Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120

TWX: 710-670-1685; TELEX: 834295; AUTOVON telephone number 422-3321. The stock number is necessary for ordering these documents and should be requested from the NAVFACENGCOM Division in your area.

DM-1	Architecture, Section 5, Safety Markings
P-309	Color for Naval Shore Facilities
DM-5	General Provisions and Geometric Design for Roads, Streets, Walks, and Open Storage Areas; Chapter 5, Section 3.3.7, Signing and Pavement Markings

North Atlantic Treaty Organization:

STANAG No. 3158	Day Marking of Airfield Runways and Taxiways

FHA Publications, U.S. Department of Transportation, Federal Aviation Agency, Washington, D.C. 20590:

FAA Standard-003	Paint Systems for Structures
	Obstruction Marking and Lighting

National Highway and Safety Administration, Washington, D.C. 20590:

Manual on Uniform Traffic Control Devices

NFPA Standards, National Fire Protection Association, Boston, Mass. 02110:

No. 33	Supply Service Stores Stock Catalog

Occupational Safety and Health Act, OSHA 1910, Department of Labor, Occupational Safety and Health Administration, Washington, D.C. 20210:

Instruction 11012.136B

The American Conference of Government Industrial Hygienists (ACGIH):

Industrial Ventilation
USA Standards Institute (formerly American Standards Association) Z35.1 Industrial Accident Prevention Signs

<u>Miscellaneous Publications</u>:

National Electrical Code for Hazardous Areas

EM 385-1-1	General Safety Requirements Manual

Note: For special SAFETY and IDENTIFICATION SIGNS consult your SAFETY ENGINEER.